FPL

10 CFR § 50.73
L-2004-229
OCT 1 8 2004

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D. C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Reportable Event: 2004-001-01
Date of Event: January 26, 2004
Installation of Ground Test Devices in Output Breakers during Startup Transformer Maintenance Causes Both Emergency Diesel Generators to be Inoperable

The attached Licensee Event Report (LER) 250/2004-001-01 is being submitted pursuant to the requirements of 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(ii), 10 CFR 50.73(a)(2)(v) and 10 CFR 50.73(a)(2)(vii) to provide notification of the subject event. This LER submission contains supplemental information and superscedes the prior submission dated March 25, 2004 (Florida Power & Light letter L-2004-068). Florida Power & Light letter L-2004-145, dated July 22, 2004, revised the target date for this supplement to October 18, 2004.

If there are any questions, please call Mr. Walter Parker at (305) 246-6632.

Very truly yours,

Terry Jones

Terry O. Jones
Vice President
Turkey Point Nuclear Plant

Attachment

cc: Regional Administrator, USNRC, Region II
Senior Resident Inspector, USNRC, Turkey Point Nuclear Plant

Rec'd 3/24/05
Orig never rec'd

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NRC FORM 366 (6-2004) U.S. NUCLEAR REGULATORY COMMISSION	APPROVED BY OMB: NO. 3150-0104 EXPIRES: 06/30/2007
LICENSEE EVENT REPORT (LER) (See reverse for required number of digits/characters for each block)	Estimated burden per response to comply with this mandatory collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records and FOIA/Privacy Service Branch (T-5 F52), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to infocollects@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202, (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose an information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
Turkey Point Unit 3	05000250	1 OF 24

4. TITLE
EDGs Inoperable by Use of GTDs in Startup Transformer Breakers

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MONTH	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO.	MONTH	DAY	YEAR	FACILITY NAME: Turkey Point U4	DOCKET NUMBER: 05000251
01	26	2004	2004	- 001 -	01	10	18	2004	FACILITY NAME:	DOCKET NUMBER: 05000

9. OPERATING MODE: 1

10. POWER LEVEL: 100

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR§: *(Check all that apply)*

☐ 20.2201(b)	☐ 20.2203(a)(3)(i)	☐ 50.73(a)(2)(i)(C)	☒ 50.73(a)(2)(vii)
☐ 20.2201(d)	☐ 20.2203(a)(3)(ii)	☐ 50.73(a)(2)(ii)(A)	☐ 50.73(a)(2)(viii)(A)
☐ 20.2203(a)(1)	☐ 20.2203(a)(4)	☒ 50.73(a)(2)(ii)(B)	☐ 50.73(a)(2)(viii)(B)
☐ 20.2203(a)(2)(i)	☐ 50.36(c)(1)(i)(A)	☐ 50.73(a)(2)(iii)	☐ 50.73(a)(2)(ix)(A)
☐ 20.2203(a)(2)(ii)	☐ 50.36(c)(1)(ii)(A)	☐ 50.73(a)(2)(iv)(A)	☐ 50.73(a)(2)(x)
☐ 20.2203(a)(2)(iii)	☐ 50.36(c)(2)	☒ 50.73(a)(2)(v)(A)	☐ 73.71(a)(4)
☐ 20.2203(a)(2)(iv)	☐ 50.46(a)(3)(ii)	☒ 50.73(a)(2)(v)(B)	☐ 73.71(a)(5)
☐ 20.2203(a)(2)(v)	☐ 50.73(a)(2)(i)(A)	☒ 50.73(a)(2)(v)(C)	☐ OTHER
☐ 20.2203(a)(2)(vi)	☒ 50.73(a)(2)(i)(B)	☒ 50.73(a)(2)(v)(D)	Specify in Abstract below or in NRC Form 366A

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
Paul F. Czaya - Licensing Engineer	305-246-7150

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED		15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
☐ YES *(If yes, complete 15. EXPECTED SUBMISSION DATE)*	☒ NO				

ABSTRACT *(Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)*

Ground test devices (GTD), installed in the Unit 3 startup transformer breaker cubicles during startup transformer maintenance, would cause the Unit 3 emergency diesel generators (EDG) to respond to a loss of offsite power (LOOP) in droop mode instead of isochronous mode. In droop mode, EDG steady state output frequency would be less than that required by Technical Specification (TS) Surveillance Requirement (SR) 4.8.1.1.2; and, therefore, both Unit 3 EDGs are considered inoperable during startup transformer maintenance. It was also determined that, with a GTD installed in the A or B Intake Cooling Water (ICW) pump or the Component Cooling Water (CCW) pump switchgear cubicle, no ICW or CCW pump would be automatically loaded during sequencer loading onto the associated EDG under LOOP conditions. Therefore, the A or B ICW or CCW pump, with the GTD device installed in its associated cubicle, and the ICW or CCW pump on the swing D Bus switchgear, would both be considered inoperable.

The cause of this event was due to a misunderstanding of the effect of the GTD used in the 4 kV cubicles on associated EDG and 4 kV switchgear control circuits, and a procedural deficiency that did not include this precaution. Procedures have been revised to install appropriate jumpers, when GTDs are installed in associated 4 kV cubicles, prior to the next maintenance or test.

DESCRIPTION OF THE EVENT

GROUND TEST DEVICES INSTALLED IN STARTUP TRANSFORMER BREAKERS

The condition described herein was identified on January 14, 2004 while preparing a temporary procedure to be used during an upcoming Turkey Point Unit 3 maintenance outage for the startup transformer [EIIS: EA, XFMR]. It was documented in Condition Report No. 04-0157. Both Unit 3 and 4 were operating at normal temperature and pressure at full power.

During startup transformer maintenance, ground test devices (GTD) [EIIS: 57] are installed in the startup transformer breaker [EIIS: BKR] cubicles. The installation of the GTDs would cause the Unit 3 emergency diesel generators (EDG) [EIIS: EK, DG] to respond to a loss of offsite power (LOOP) event in the droop mode, instead of the desired isochronous mode. In droop mode, EDG steady state output frequency would be less than required by Technical Specification SR 4.8.1.1.2; and therefore, both Unit 3 EDGs would be considered inoperable during startup transformer maintenance, when the GTDs are installed. The condition exists anytime the Unit 3 startup transformer is out of service with the GTD devices racked into the startup transformer breaker cubicles. This condition is not applicable to Unit 4 EDGs, as they have a different control circuit design.

After evaluation, this condition was determined to be reportable on January 26, 2004 in accordance with 10 CFR 50.73(a)(2)(i)(B), 10 CFR 50.73(a)(2)(ii)(B), 10 CFR 50.73(a)(2)(v)(A), (B), (C), (D) and 10 CFR 50.73(a)(2)(vii).

GROUND TEST DEVICES INSTALLED IN INTAKE AND COMPONENT COOLING WATER BREAKERS

As a result of the condition identified with GTDs installed in startup transformer breakers, an extent of condition review was performed to determine if other systems and/or components may be similarly affected. The review determined that with a GTD installed in the A or B Intake Cooling Water (ICW) [EIIS: BS] pump or the Component Cooling Water (CCW) [EIIS: CC] pump switchgear [EIIS: SWGR] cubicle, the respective ICW or CCW pump [EIIS: P] would not be automatically loaded during sequencer loading onto its associated EDG for a LOOP. Therefore, the A or B ICW or CCW pump, with the GTD device installed in its associated cubicle, and the ICW or CCW pump on the swing D Bus switchgear, would both be considered inoperable. This configuration is allowed for up to 72 hours by Technical Specifications. However, three instances were identified since 2001 where, due to the installation of the GTDs, during individual ICW or CCW pump maintenance, the 72 hour allowed outage time was exceeded and the action required was not taken.

This condition was determined to be reportable on February 10, 2004 in accordance with 10 CFR 50.73(a)(2)(i)(B).

BACKGROUND

GROUND TEST DEVICES INSTALLED IN STARTUP TRANSFORMER BREAKERS

There are two startup transformers, one for each Turkey Point Unit 3 and Unit 4. The startup transformers are connected to the 240 kV buses [EIIS: SSBU] on their primary sides and have two secondary windings at 4.16 kV. The startup and C bus transformers serve the unit during startup, shutdown, and after a unit trip. The C bus transformers are isolated from their respective startup transformer. The startup transformer also constitutes a standby source of auxiliary power in the event of the loss of the unit auxiliary transformer during normal operation. In the event the main turbine [EIIS: TRB] trips, an automatic transfer connects A and B 4.16 kV buses to the unit startup transformer.

GTDs are used to ground the output side of switchgear cubicles to ensure worker safety during maintenance.

When the Unit 3 startup transformer is taken out of service for maintenance, a GTD is installed/racked up in startup transformer switchgear cubicles 3AA05 and 3AB05. The Unit 3 EDG circuit senses startup transformer breaker and auxiliary transformer breaker positions, to determine the desired mode of operation. With the GTDs installed in the startup transformer breaker cubicles, the breaker contacts respond as follows:

Stationary contacts (152) will remain in their breaker "Open" position, since the breaker was opened prior to racking it out and the GTD does not have a plunger to actuate the 152/STA switch [EIIS: 33].

Auxiliary contacts (152) all appear as open circuits, since the contacts are connected via stabs that are disconnected when the breaker is removed.

152/HH contacts reflect the elevator position and will respond the same, regardless of whether the breaker is installed or the GTD is installed. The 152 HH contact of significance is contact 5-5T, which is used in the portion of the EDG circuit that controls EDG mode of operation. This 5-5T contact is open, since the GTD is in the racked up position.

The Unit 3 EDG control circuit recognizes the above contact logic as the startup transformer breaker being racked in and closed. If a LOOP was to occur during this time, the EDGs would start and energize their respective 4 kV buses, but the EDG governor [EIIS: 65] would be in droop mode, instead of the desired isochronous mode.

The operation of the EDG voltage regulator [EIIS: RG] is not dependent on startup transformer breaker and auxiliary transformer breaker position. The voltage regulator on the Unit 3 EDGs always operates in droop mode. Therefore, for a LOOP condition, the voltage regulator would respond as required, regardless of the GTD being installed in the startup transformer breaker cubicles.

Other control circuits that have inputs from the startup transformer breaker cubicle contacts and that could be affected by having the GTD racked in the cubicles were reviewed. No additional incorrect equipment logic/operation was identified. For a LOOP scenario, each EDG would start and accelerate to the required speed and voltage. The load sequencer would not be affected and would respond as required. The EDG breakers would close on the isolated buses and the loads sequentially loaded. The only adversely affected response is that the EDG governor would be in droop mode, instead of isochronous mode.

Droop is a characteristic of a diesel generator governor that results in lower speed as load increases. The EDG governor controls diesel engine [EIIS: ENG] speed to counter the droop effect and maintain desired EDG operation.

Isochronous mode is used when the EDG is operating as an isolated generator. The EDG governor compares the EDG output frequency signal to the established reference frequency and increases or decreases fuel (throttle) to the engine, as required to maintain the established 60 Hz reference frequency.

Droop mode is used when an EDG is paralleled with other larger generators, since the frequency is dictated by the larger generator system. The governor has an established droop value (%) setting, which is typically based on the kW rating of the EDG for the governor. Since the grid system is controlling frequency, the governor droop setting allows the diesel to be throttled by raising its reference point (speed adjuster) above the normal 900 RPM reference, and thereby pickup some of the grid system kW load. In droop mode, the EDG governor again uses the EDG output frequency signal, but, in this case, it also adds in the associated droop signal based on the load; it then compares this total frequency value to the established reference frequency. The governor increases or decreases fuel to the diesel, as required to obtain the established 60 Hz reference frequency. The droop circuit, in effect, sends a false signal (high) to the governor circuit, since the output frequency has not been actually restored to the reference frequency.

An isolated EDG operating with the governor in droop mode and no load will operate at an engine RPM speed equal to a 60 Hz frequency. Engine RPM/generator frequency will decrease as the EDG is loaded. For example, at rated full load of 2500 kW and a 6% droop governor setting, the EDG frequency will be lowered by a percentage equal to the droop setting, i.e., 56.4 Hz. The effect of the droop in speed/frequency is equivalent to the ratio of the actual EDG load to the EDG full load rating. In other words, at 500 kW the engine speed and generator frequency would be approximately 1.2% lower with a 6% droop setting. Generator output voltage is also related to generator speed. As such, generator output voltage will drop as engine speed drops. The EDG voltage regulator would normally restore the generator output voltage to the original reference point. However, the EDG magamp voltage regulator circuit is designed to operate in reference to a 60 Hz signal. The lower frequency sensed by the voltage regulator circuit results in a proportional change in voltage regulator reference voltage that it is responding to. As a result, the EDG voltage drop due to the lower speed of the generator remains and the voltage regulator only responds to changes that vary from that new voltage reference. Therefore, an isolated EDG operating with the governor in droop mode results in lower frequency and voltage that is directly related to the EDG kW load.

FACILITY NAME (1)	DOCKET NUMBER (2)	LER NUMBER (6)			PAGE (3)
		YEAR	SEQUENTIAL NUMBER	REVISION NUMBER	
Turkey Point Unit 3	05000250	2004	- 001	- 01	Page 5 of 24

TEXT (If more space is required, use additional copies of NRC Form 366A) (17)

GROUND TEST DEVICES INSTALLED IN INTAKE AND COMPONENT COOLING WATER BREAKERS

The Component Cooling Water System is designed as a closed-cycle system composed of a surge tank [EIIS: TK], three pumps, three heat exchangers [EIIS: HX], a pump supply header, a header between the pump discharges and CCW heat exchanger inlets, a heat exchanger outlet header, and piping to and from various loads. The pumps are each 100% capacity and the heat exchangers are each 50% capacity. The headers are normally in an open configuration, such that the pumps share a common supply and a common discharge, and the heat exchangers share a common outlet. Heat is removed from the CCW system by the flow of Intake Cooling Water through the tube [EIIS: TBG] side of the CCW heat exchangers. The closed cycle design assures a monitored intermediate barrier between the components handling reactor coolant system fluid and the ultimate heat sink.

The design basis of the CCW System is to provide sufficient heat removal from the Engineered Safety Features to the ultimate heat sink (ICW System) under post accident conditions. The system is designed with sufficient capability to accommodate the failure of any single, active component without resulting in undue risk to the health and safety of the public, following a Maximum Hypothetical Accident (MHA). The most limiting single active failure considered is the loss of one emergency diesel generator, which results in only one CCW pump starting automatically to mitigate the consequences of the MHA. The combination of one CCW pump supplying two CCW heat exchangers is the design basis capability for meeting accident heat loads.

The ICW System provides cooling water to the CCW heat exchangers. The ICW System includes three ICW pumps, tie headers, two independent supply headers, piping, valves [EIIS: V], and basket strainers [EIIS: STR] that are required to provide ICW from the plant cooling canals, via the intake structure, supply the CCW heat exchangers, and then return ICW to the plant cooling canal system. The ICW System removes the heat load from the CCW System during accident conditions to support both reactor heat removal and containment heat removal requirements.

The extent of condition review determined that installed GTDs during maintenance also affect the Unit 3 and 4 4 kV Bus A, B and C switchgear cubicles for the corresponding and impact the starting of ICW and CCW pumps when required.

CAUSE OF THE EVENT

Ground test devices in the 4 kV breaker cubicles during maintenance activities have been used at Turkey Point since the late 1970s. While preparing a temporary procedure for an upcoming plant modification, Engineering identified the GTD condition and its potential effect during maintenance activities on the EDG and the ICW and CCW pumps. The cause of this event was due to a misunderstanding of the effect of the GTD used in the 4 kV cubicles on associated EDG and 4 kV switchgear control circuits, and a procedural deficiency that did not include this precaution.

ANALYSIS OF THE EVENT

GROUND TEST DEVICES INSTALLED IN STARTUP TRANSFORMER BREAKERS

This condition would not challenge the EDG engine in any manner. The type of engines used at Turkey Point are designed to operate at full load, between 750 RPM (50 Hz) and 900 RPM (60 Hz) in genset applications. Oil and coolant flow is sufficient to prevent engine damage. The positive displacement fuel pump provides excess fuel flow, which is bypassed back to the skid-mounted tank. A reduction in engine speed will provide a slight reduction in the amount of fuel bypassed and thus would not limit horsepower. The capacity of the radiators [EIIS: HX] are more than adequate for the 100% load rating; therefore, a slight reduction in air flow due to the lower speed would have little impact other than at worst case, a slight increase in coolant temperature. The Unit 3 EDGs typically do not have the thermostatic valves [EIIS: TCV] fully open, with some coolant bypassing the radiator; a reduction in air flow may reduce the bypass flow, with no resultant change in engine operating temperature. The slight reduction in nominal horsepower caused by a reduction in speed is easily made up by the reserve power provided by additional fuel flow from the injectors. Total fuel used would be very similar in either droop or isochronous operation. A 5% frequency reduction would result in a reduction in horsepower required by driven equipment; and, as such, the horsepower demand on the engine would be less. Engine response to load blocks would be essentially the same, since engine response is dependent upon governor response and the reserve power is available to accelerate the engine back to the new load level. The reserve power and governor response do not change between the droop and isochronous modes. Therefore, there is no adverse effect on the engine operation on an isolated bus in droop mode.

Unit 3 EDG Droop Settings

Engineered Safeguards Integrated Testing (ESIT), Procedure 3-OSP-203.1, includes an EDG load rejection test with EDG load >2500 kW. Review of the ESIT Unit 3 EDG load rejection chart tracing for EDG 3A, dated 8/17/2000, shows approximately a 6.3% droop effect in frequency and for EDG 3B, dated 10/15/01, shows approximately a 6.0% droop effect in frequency. The frequency increases upon rejecting the >2500 kW load. This is because the EDG was paralleled to the grid and the operator loaded the EDG by raising the governor reference point above that for no load (60Hz). When the EDG breaker is opened and the grid is no longer controlling the frequency, the EDG goes to the last reference point set by the operator. The opposite effect occurs if the EDG is isolated in droop mode, as the EDG reference point is fixed at 60 Hz, so EDG frequency droops downward from the fixed reference points at full load.

As previously stated, the EDG voltage regulator is not affected by the GTD being installed in the startup transformer breaker cubicles. However, the reduction in frequency, due to the governor being in droop mode, will create a voltage drop in generator output voltage. On 3/18/03 EDG 3B was inadvertently put in the droop mode for a short time while operating as an isolated EDG during ESIT. The EDG was approximately 25% loaded (625 kW) at the time. Review of the real time traces of the event show that voltage dropped approximately 65 volts, which equates to 1.5% drop in voltage. This voltage drop is attributed to the drop in frequency caused by the EDG governor being in droop. With a 6.3% governor droop and an EDG load of 625 kW, the expected resulting drop in frequency would be approximately 0.95

Hz (i.e., 1.5%). This shows that a 1.5% drop in frequency resulted in an equal 1.5% drop in generator output voltage as expected. The drop in voltage is directly proportional to the drop in frequency, so at full load of 2500 kW, the voltage drop would be approximately 6.3 % or 263 volts.

Effect on EDG Transient Response during Sequencer Loading

Based on the ESIT load rejection tracing, the Unit 3 EDG electronic governor droop is approximately 6.3% to 6.0% based on the 2500 kW rating. For the following evaluation of EDG transient response during sequence loading, the higher number of 6.3% droop is used with an associated equal % drop in voltage. Note: as EDG load is increased, the % droop will increase proportional to the ratio of the actual EDG load to the full load rating. For the EDG 3A LOOP/LOCA (loss of coolant accident) load blocks (LB) 1 through 7, the expected % droop and the expected resulting frequency and voltage are as follows. EDG 3B loads are slightly different, but would generally provide the same results.

EDG 3A

Load Block	kW load	Total kW	% droop	Frequency Drop	Voltage Drop
1	208	208	0.52	0.31(Hz)	22(V)
2	524	732	1.84	1.1	77
3	235	967	2.42	1.45	101
4	265	1232	3.1	1.86	129
5	380	1612	4.03	2.42	168
6	55	1667	4.2	2.52	175
7	55	1722	4.31	2.6	179
Total auto and manual loads		2079	5.20	3.12	216

Engineering Evaluation JPN-PTN-SEEP-92-016, Revision 0 established the criteria for EDG 3A and 3B voltage and frequency during ESIT sequencer loading. The worst case frequencies and voltages for EDG 3A or 3B for each load block identified in the evaluation are shown below. The above load block frequency and voltage drops due to the EDG operating in droop mode, are added to the established drops and the totals compared to the ESIT Procedure 3-OSP-203.1 acceptance criteria.

VOLTAGE

Load Block	Worst Case LB (V)	Droop Drop (V)	Total Drop (V)	Acceptance Criteria (V)
1	3512	-22	3490	3120
2	2615	-77	2539	2484
3	3365	-101	3264	3120
4	3204	-129	3075	3044
5	3151	-168	2983*	2994
6	3839	-175	3664	3120
7	3839	-179	3660	3120

* The total voltage drop values remain within the ESIT Procedure 3-OSP-203.1 acceptance criteria, except for load block 5, which is within 11 volts of the acceptance criteria.

FREQUENCY

Load Block	Worst Case LB (Hz)	Droop Drop (Hz)	Total Drop (Hz)	Acceptance Criteria (Hz)
1	59.2	-0.31	58.9	57
2	58.4*	-1.1	57.3	57
3	58.8*	-1.45	57.3	57
4	58.5*	-1.86	56.6*	57
5	58.7*	-2.42	56.2*	57
6	59.5*	-2.52	57.0*	57
7	59.6*	-2.6	57.0	57

* The worst case frequency numbers are the Dynamic Load Study calculated prediction values. Neither the Dynamic Load Study testing actual load block frequency numbers nor recent ESIT tracings show a frequency drop below 59 Hz for load blocks 1 through 5 and 59.8 Hz for load blocks 6 and 7. Total frequency drop for load block 4 and 5 would be 57.1 Hz and 56.6 Hz, respectively, based on 59 Hz. Total frequency drop for load block 6 and 7 would be 57.3 Hz and 57.2 Hz, respectively, based on 59.8 Hz.

The reduction in frequency and voltage for the respective LOOP/LOCA load blocks, due to the EDG being in droop mode, would remain within the transient acceptance criteria of the ESIT, with one exception. The only exception is the frequency and voltage drop for load block 5, which are very close to the acceptance criteria values. Although load block 5 might momentarily dip below 57 Hz to 56.6 Hz and voltage below 2994 volts to 2983 volts, the EDG will quickly restore frequency and voltage above 57 Hz and 2994 volts. It is shown in the recent ESIT LOOP/LOCA chart tracing that load block frequency dips recover quickly (i.e. < 2 seconds) with typically 4 to 5 seconds of steady state frequency until the next load block. In emergency mode, the only EDG trips in effect are overspeed and generator differential. Neither of these trips can be actuated under this EDG operating condition and diesel engine speed and voltage would recover, with only a fraction of a second increase in recovery time. In addition, the numbers used to determine the frequency and voltage drop in this evaluation are conservative, and it is expected that the voltage and frequency would remain within the acceptance criteria. Any slight increase in frequency and voltage load block recovery time will not adversely affect the starting of associated motors/pumps.

The above EDG transient response analysis is for LOOP/LOCA loading. For LOOP only there are only 3 automatic load blocks (load blocks 1, 4 and 5) with a total automatic load of 959 kW. Load block 5 (worst case above) would only have a total drop in frequency to 57.3 Hz. Therefore, all load blocks for a LOOP only condition would remain within the 57 Hz acceptance criteria.

At the time the condition was identified during maintenance planning, the GTDs were not installed in the startup transformer cubicles, and the Unit 3 startup transformer was not out-of-service. Therefore, there was no current operability concern.

Past Operability Assessment

Racking in GTDs in the startup transformer cubicles during Unit 3 startup transformer outages operates contacts in the respective EDG control circuits, creating logic indicating that the transformer output breakers are closed. This then places EDG voltage/frequency control in droop mode. In this condition, any EDG startup and loading would result in EDG output voltage and frequency lower than nominal.

As discussed in the above evaluation, the expected frequency and voltage would be approximately 57.0 Hz and 3950 volts with each EDG loaded to 2500 kW and operating as isolated EDGs in droop mode.

In accordance with Technical Specification SR 4.8.1.1.2, the EDG surveillance requirement for frequency is 60 ± 1.2 Hz and for voltage, 4160 ± 420 volts at a steady state condition.

Based on the above, voltage would remain within the technical specification requirement but frequency would be lower than the required minimum of 58.8 Hz. Therefore, both Unit 3 EDGs would be inoperable in accordance with the Technical Specifications.

Since the identified condition had not been previously recognized, it is believed that each Unit 3 startup transformer test performed using these GTDs would have rendered both EDGs inoperable during the testing. Prior to changing the test period requirement to every 24 months, this periodic testing was performed on an 18-month cycle, roughly in line with core reload cycles. An assessment of the Unit 3 Startup Transformer maintenance periods is provided below:

- In October 2001, the Unit 3 Startup Transformer was out of service with the subject GTD racked in for approximately 11 days, during unit shutdown for transformer replacement. However, in this case, jumpers were installed by a Temporary Procedure, such that the EDG inoperability condition did not exist. This was not an event.

- In July 2000, the Unit 3 Startup Transformer was out of service with the subject GTD racked in for approximately 36 hours for maintenance. This placed the Unit 3 A and B EDGs out of service for the same period.

Although the last instance of this event for a Startup Transformer outage (July 2000) was more that three (3) years from time of discovery in 2004, the event is noteworthy enough to be considered reportable under several 10 CFR Sections.

Reportability

A review of the reporting requirements of 10 CFR 50.72 and 10 CFR 50.73 and NRC guidance provided in "Event Reporting Guidelines," 10 CFR 50.72 and 10 CFR 50.73 (NUREG-1022, Rev. 2) was performed for the subject condition. As a result of this review, the condition is reportable as described below.

1. Part 50.73(a)(2)(i)(B) of Title 10 CFR states that the licensee shall report "Any operation or condition which was prohibited by the plant's Technical Specifications except when:

   (1) The Technical Specification is administrative in nature;
   (2) The event consisted solely of a case of a late surveillance test where the oversight was corrected, the test was performed, and the equipment was found to be capable of performing its specified safety functions: or
   (3) The Technical Specification was revised prior to discovery of the event such that the operation or condition was no longer prohibited at the time of discovery of the event."

Racking in the GTDs in the startup transformer cubicles during Unit 3 startup transformer outages operates contacts in the respective EDG control circuits, creating logic indicating that the transformer output breakers are closed. This then places EDG frequency control in droop mode. In this condition, any EDG startup and loading would result in EDG output voltage and frequency lower than nominal. Subsequent loading would reduce frequency below that required by Technical Specification SR 4.8.1.1.2, thus making both Unit 3 EDGs inoperable. With two of four on-site EDGs inoperable, TS Limiting Condition for Operation (LCO) 3.8.1.1.b is not met.

Additionally, TS LCOs 3.8.1.1.a and 3.8.1.1.b, together, require operability of a minimum of two startup transformers and three independent EDGs for each unit. Technical Specification 3.8.1.1, Action c states that with one startup transformer and one of the required EDGs inoperable, demonstrate the operability of the remaining AC sources in accordance with specified surveillance requirements. There is no Action associated with the subject condition of one startup transformer and two EDGs inoperable. Therefore, Technical Specification 3.0.3 applies. Since the condition has not been previously recognized, the requirements of TS 3.0.3 to initiate actions to shutdown the unit within one hour have not been met each time the startup transformer was taken out of service for testing and the subject GTDs racked in.

Therefore, this condition is considered reportable under 10 CFR 50.73(a)(2)(i)(B).

2. Based on the evaluation above, additional reporting criteria were considered as discussed below:

   a.) 10 CFR 50.73(a)(2)(ii) states that the licensee shall report, "Any event or condition that resulted in:

      "(B) The nuclear power plant being in an unanalyzed condition that significantly degraded plant safety."

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The described condition would place EDG governor control in droop mode for both Unit 3 EDGs. Since this would result in EDG output frequency below that required by TS SR 4.8.1.1.2, both Unit 3 EDGs would be inoperable in this configuration.

NRC event reporting guidelines, NUREG-1022, Rev. 2, recognizes that any trivial single failure or minor error in performing surveillance tests could produce a situation where two or more unrelated, safety-grade components are out of service. The guidance states that these events should be reported only if they involve functionally related components or if they significantly compromise plant safety.

Since the condition would render both Unit 3 EDGs inoperable, and they are functionally related, the condition is considered reportable under 10 CFR 50.73(a)(2)(ii)(B).

b) 10 CFR 50.73(a)(2)(v) states that the licensee shall report "Any event or condition that could have prevented the fulfillment of the safety function of structures or systems that are needed to:

(A) Shut down the reactor and maintain it in a safe shutdown condition;
(B) Remove residual heat;
(C) Control the release of radioactive material; or
(D) Mitigate the consequences of an accident."

As stated previously, the use of GTDs in the startup transformer cubicles during Unit 3 startup transformer outages would reduce frequency below that required by TS SR 4.8.1.1.2, rendering both Unit 3 EDGs inoperable. The inoperability of the required number of EDGs could have prevented the ability to ensure proper fulfillment of required safety functions of components needed under this regulation; therefore, the reported condition is considered reportable under 10 CFR 50.73(a)(2)(v)(A), (B), (C) and (D).

c) 10 CFR 50.73(a)(2)(vii) states that the licensee shall report, "Any event where a single cause or condition caused at least one independent train or channel to become inoperable in multiple systems or two independent trains or channels to become inoperable in a single system designed to:

(A) Shut down the reactor and maintain it in a safe shutdown condition;
(B) Remove residual heat;
(C) Control the release of radioactive material; or
(D) Mitigate the consequences of an accident."

The described condition is the design and use of GTDs during startup transformer outages that would have made both Unit 3 EDGs inoperable. While these are two separate test devices, they are both required to be used to ground the output side of the transformers to ensure worker safety during subsequent transformer testing and are thus considered a single cause or condition.

As stated above, both Unit 3 EDGs would have been inoperable during use of these GTDs while performing startup transformer maintenance. Therefore, the condition is considered reportable under 10 CFR 50.73(a)(2)(vii).

GROUND TEST DEVICES INSTALLED IN INTAKE AND COMPONENT COOLING WATER BREAKERS

The extent of condition review determined that installed GTDs during maintenance also affect the Unit 3 and 4 4 kV Bus A, B and C switchgear cubicles. The 4 kV Bus D switchgear cubicles have a different breaker racking mechanism and a different GTD. The 4 kV Bus D switchgear GTD does not have a pin that would activate the 152H switch. Therefore, the 4 kV Bus D switchgear is unaffected.

The 4 kV Bus A, B and C switchgear 152HH (A and B Bus cubicles) or 152TOC (C Bus cubicles) contacts reflect the breaker position within the cubicle and respond the same regardless if the breaker is installed or the GTD is installed. With the GTD installed and racked in the cubicle, portions of the associated breaker's close and the trip control circuit remains energized and active. In addition, 152HH or 152TOC contacts, with external control circuits connected, will reflect a breaker racked in condition in those circuits. The breaker/cubicle's 152HH or 152TOC contacts for all the Unit 3 and 4 GE 4 kV Bus A and B switchgear cubicles were reviewed for the effect on the contact's associated control circuits when the GTD is installed. Most of the switchgear cubicles have no adverse effect on plant systems and require no additional action to be taken when the GTD is installed. The Unit 3 and 4 Feedwater (FW) [EIIS: SJ], Intake Cooling Water and Component Cooling Water pump switchgear cubicles were identified as having an effect on plant systems and require additional actions to be taken when the GTD is installed. These items are discussed in the analysis of safety significance section below.

Reportability

10 CFR 50.73(a)(2)(i)(B) states that the licensee shall report "Any operation or condition which was prohibited by the plant's Technical Specifications except when:

(1) The Technical Specification is administrative in nature;
(2) The event consisted solely of a case of a late surveillance test where the oversight was corrected, the test was performed, and the equipment was found to be capable of performing its specified safety functions; or
(3) The Technical Specification was revised prior to discovery of the event such that the operation or condition was no longer prohibited at the time of discovery of the event."

Racking in GTDs in a Turkey Point Unit 3 or 4 A or B bus CCW or ICW pump breaker cubicle during a pump outage will operate contacts that maintain portions of the associated breaker's close and trip control circuits energized and active. As indicated in the above evaluation, contacts with external circuits connected will therefore project the logic indicating that the breaker is racked in. The D bus provides power to the 3C and 4C CCW and ICW pumps. The D bus is powered selectively from either the A or B bus.

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Under LOOP conditions, only one ICW pump and one CCW pump are designed to be automatically loaded via the sequencer on each EDG. The control circuits for the 3C and 4C CCW and 3C and 4C ICW pumps on the respective unit's D bus will only permit automatic loading of these pumps onto the EDG by the sequencer, if the associated A or B bus CCW/ICW pump breaker is not racked in. As such, racking in the GTD for the 3A, 3B, 4A or 4B CCW pump or the 3A, 3B, 4A or 4B ICW pump will prevent a start signal to the associated D bus powered C CCW or ICW pump breaker. As such, the respective ICW or CCW pump would not be automatically loaded during sequencer loading onto its associated EDG for a LOOP (one pump racked out, the other blocked by GTD-created logic). Since automatic starting of an ICW/CCW pump on a safety injection and/or LOOP signal is required for operability, only one pump was effectively operable for the affected system.

Technical Specification 3/4.7.2, Action b requires that "With only one CCW pump operable or with two CCW pumps operable but not from independent power supplies, restore two pumps from independent power supplies to operable status within 72 hours or be in hot standby within the next six hours and in cold shutdown within the following thirty hours."

TS 3/4.7.3, Action b requires that "With only one ICW pump operable or with two ICW pumps operable but not from independent power supplies, restore two pumps from independent power supplies to operable status within 72 hours or be in hot standby within the next six hours and in cold shutdown within the following thirty hours."
An assessment indicates that, since 2001, Turkey Point Units 3 and 4 have each exceeded the allowable outage time of TS 3/4.7.2 Action b once. Additionally, Unit 4 has exceeded the allowable outage time of TS 3/4.7.3 Action b once.

- In August 2002, the 3A CCW pump was out of service with the subject GTD racked in for approximately 130 hours (~58 hours over the 72 hour allowed outage time), effectively placing the 3C CCW pump out of service for the same period.

- In October 2002, the 4A ICW pump was out of service with the subject GTD racked in for approximately 77 hours (~5 hours over the 72 hour allowed outage time), effectively placing the 4C ICW pump out of service for the same period.

- In November 2002, the 4B CCW pump was out of service with the subject GTD racked in for approximately 131 hours (~59 hours over the 72 hour allowed outage time), effectively placing the 4C CCW pump out of service for the same period.

Therefore, the condition is considered reportable under 10 CFR 50.73(a)(2)(i)(B).

ANALYSIS OF SAFETY SIGNIFICANCE

Based on the analysis described below, it is concluded that the health and safety of the public were not affected by this event.

SAFETY SIGNIFICANCE OF GROUND TEST DEVICES INSTALLED IN STARTUP TRANSFORMER BREAKERS

As discussed above, an isolated Unit 3 EDG operating in droop mode would have an initial frequency of 60HZ, with no load and would decrease as load increased. At full load of 2500 kW, the frequency would be approximately 56.2 Hz. The LOOP/LOCA Unit 3 EDG loading is approximately 2079 kW. Thus, at 2079 kW the steady state frequency and voltage would be approximately 56.9 Hz and 3944 volts, respectively. The effects on AC powered components are addressed below.

Effect On Motor Operation (Running and Starting)

Motors [EIIS: MO] are designed to the NEMA MG-1 standard. MG-1 Part 12, Section 1-12.44.1, "Variations from Rated Voltage and Frequency – Running," states that alternating current motors shall operate successfully under running conditions at rated loads with a 10% variation of voltage and 5% variation in frequency. Section 1-12.44.2, "Starting," states medium motors shall start and accelerate to running speed a load which has torque characteristics and an inertia value not exceeding that listed in MG 1-12.50, with the voltage and frequency variations specified stated in Section 1-12.44.1.

From the above, at 2500 kW, a 6.3% variation in frequency equates to a range of 56.2 Hz to 63.8 Hz for 60 Hz motors. As discussed above, the worst case frequency for the Unit 3 EDGs would be a range of 56.9 Hz to 63.1 Hz, for a LOOP/LOCA condition, with an expected full load of approximately 2079 kW. For a LOOP only, the frequency for the Unit 3 EDGs would be a range of 57.5 Hz to 62.5 Hz, based on total loading of 1655 kW. The lower frequency might create a slight increase in motor heating, thus reducing life expectancy; but this condition is considered insignificant for short periods of time. Therefore, the motors are expected to operate as required.

Effect On Inverter (Vital AC)/Battery Charger Operation

The vital 120 volt AC system is powered through inverters [EIIS: INVT] that get their input source primarily from the vital 125 volt DC busses, which are powered from the battery chargers [EIIS: BYC] and/or station batteries [EIIS: BTRY]. The vital AC system can also be powered by 480 volt Constant Voltage Transformers (CVT). However, the inverter will only synchronize to an alternate source (CVT) that is between 59.3 and 60.7 Hz, and will automatically default to the DC source for a LOOP condition. The battery chargers are powered by the vital 480 volt system. The chargers have a ±10% voltage and ±5% frequency input design range. The expected LOOP/LOCA EDG loading resulting frequency of 56.9 Hz, as compared to the battery charger input design frequency (57 Hz), would not be expected to significantly alter the triggering of the SCRs, and subsequently, the rectifying function of the chargers. The voltage reduction of 216 volts at 4160 volts is equivalent to 25 volts at 480 volts, and is well within the 480-volt ±10% design rating. The battery charger alone (without the battery) would be expected to continue to provide sufficient filtering of the AC ripple on the DC output. However, the battery is always installed and the battery effectively filters any AC ripple and can also provide the required DC voltage without a charger for 2 hours, if needed. As such, the DC input into the inverters will be unchanged by the lower frequency, resulting from the EDG governor being in droop mode during a LOOP. Therefore, all Vital AC and DC components are expected to function/operate as required.

Effect on Mechanical Equipment for LOOP and LOOP/LOCA at 5% Speed Reduction

To determine the effects on AC powered components, an evaluation of motor operated valves performance, containment heat removal capability, and emergency core cooling pumps' capability was performed for the event conditions.

Motor Operated Valve Performance

A reduction in electrical system frequency would result in increased motor operated valve stroke times. Such would be the case for automatically operated MOVs actuated by an accident signal, and for MOVs manually actuated by operator action. Such increased valve stroke times is not considered to adversely affect design basis functions for the following reasons:

- Automatically operated MOVs are actuated in the first EDG load block when the reduced frequency effect is at a minimum
- Maximum valve liftoff torque requirements for automatically operated MOVs occurs upon initial energization, when the reduced voltage and frequency effects are at a minimum
- Increased valve stroke time of up to 5.2% is considered negligible with respect to satisfying accident analysis requirements (margin exists in flow delivery assumptions)
- Based on valve types, the majority of flow is typically available with the valve less than 25% open.
- The timing for MOVs manually actuated by operator action is not time critical. Additionally, operation of these valves is likely to occur following discovery and correction of the subject condition.

Pump Performance Impact

EDG droop mode operation results in a nominal 5% reduction in frequency, whereby pump flow and head were reduced by approximately 5% and 10%, respectively. As this evaluation is for functionality rather than design purposes, degraded performance is assessed with respect to actual pump performance (in-service test results) rather than design limits. Screening reviews determined that performance of several pumps, in event of demand, would have exceeded or just barely missed satisfying Technical Specification minimum limits. However, affinity laws were used to develop more definitive flows based on a 10% head reduction for use in revisiting accident mitigation capability.

For other support and accident mitigation components, the extent and effects of degraded performance are assessed directly and based on relevant test data, where available. For the Containment Spray (CS)

[EIIS:BE] pumps, test data indicates 7% and 10% margin above acceptance criteria for the worst data points for Pumps 3A and 3B, respectively. With a 10% reduction in head, only Pump 3A performance would be considered degraded 3%. Even so, there is inherent margin between maximum and peak accident pressure for the containment [EIIC: NH] integrity analyses and results indicate at least a 10% margin between design and peak accident temperatures even with one pump operating, as indicated in UFSAR Section 14.3.4.3. Therefore, having Pump 3A degraded by 3% would not have resulted in compromised containment integrity.

The Emergency Containment Coolers (ECC) [EIIS: BK, EIIC: CLR] are also credited for pressure and temperature mitigation to support containment integrity and equipment qualification. Two ECCs operate under design basis accident scenarios. Degraded frequency would slow fan [EIIC: FAN] speed as well as CCW flow to the coolers; however, lower flows increase air/tube contact time that tends to increase cooling efficiency per unit volume of air passing over the tube bank. Though not providing full compensation, the effect tends to counteract reduced airflow. Furthermore, even with degraded performance and design basis assumptions of a single CS pump and two ECCs, the margin in accident analyses is sufficient to envelop any resultant increase in containment peak temperature and pressure.

Test data for the ICW and CCW pumps indicate a relatively wide range of performance capability. Imposing a 10% head reduction due to droop on the worst performance datum point of each pump, respective pump performance relative to the design basis is indicated in the following table (N/A if design basis is met):

ICW Pump	*Degraded Head*	*CCW Pump*	*Degraded Head*
3A	1%	3A	N/A
3B	N/A	3B	3.1%
3C	2.7%	3C	N/A

The effects of degraded ICW and CCW pump performance are not expected to significantly impact accident analysis results. The largest heat loads on the CCW System are the ECCs during the blowdown phase and the RHR [EIIS: BP] heat exchangers during the recirculation phase. Analyses for CCW System performance assume steady-state peak conditions with 95°F ICW at the heat exchanger inlet. In fact, the large water inventory in the CCW System provides inherent inertia to retard the rate of CCW temperature increase such that actual peak CCW temperature would substantially lag containment peak temperature during blowdown. This and lower ICW temperatures combine to enhance RHR during recirculation. Data tracked by the system engineer indicates ICW supply temperatures during the summer peak months of Unit 3 Cycle 18 (Cycle 18 covers the period when GTDs were installed in startup transformer output breakers during July 2000) are in the upper 80s or low 90s, substantially below the 95°F used in design basis analyses. Even the highest temperature recorded of 93.66°F on July 24, 2000 provides margin below design. In addition, substantial margins afforded by conservative assumptions in initial conditions would be expected to envelop effects of degraded ICW and CCW pump performance, discussed in the Containment Response section below.

Containment Response Impact

Containment pressure, following a LOOP/LOCA event, is maintained below the 55 psig design value by a combination of passive and active heat removal mechanisms. Passive heat removal occurs via the transfer of heat to the containment structural heat sinks. Active heat removal occurs via operation of the containment spray system and emergency containment coolers. Of the two, passive heat removal is the most significant heat removal mechanism during the early portion of the transient. It actually limits the peak pressure during the blowdown phase and begins to reduce the terminal pressure during the reflood phase, before the active heat removal systems begin operation. Due to the rapid nature of the reactor coolant system [EIIS: AB] depressurization following a large break LOCA, the active containment heat removal systems do not impact the blowdown peak pressure; however, they function to reduce the containment pressure after blowdown, and maintain a low long-term pressure during the recovery period. The containment structure also contributes significantly as a form of heat removal throughout the event.

Under the most limiting single active failure condition, active heat removal would be provided by one train of containment spray and two emergency containment coolers. The current containment integrity analysis assumes that one train of containment spray and one emergency containment cooler automatically actuate. A second containment cooler is manually started 24 hours later.

Containment analysis bounding conditions are described in UFSAR Sections 14.2.5.2 and 14.3.4.3 for responses to a main steam line break (MSLB) and large-break LOCA (LBLOCA). The analyses assume initial conditions at +3.0 psig and 130°F. Actual bulk containment temperature is normally ≤ 120°F and up to 125°F for only short periods (2 weeks cumulative per year) during peak canal temperatures. Also, the design pressure of 55 psig includes greater than 10% margin above LOCA peak pressure. Based on conservative assumptions and margins, the UFSAR analyses are considered bounding to effects of degraded component performance.

Operational Controls Impact

Actuation signals and reactor controls, which are battery-backed, would not have been affected by droop conditions. Similarly, performance of instrument air-controlled or powered components would not have been hindered. Specific component functions, including dc-powered Auxiliary Feedwater (AFW) [EIIS: BA] steam supply valves [EIIC: ISV], AFW flow control valves [EIIC: FCV], Main Steam Isolation Valves (MSIV) and Atmospheric Dump Valves (ADV) [EIIC: RV], assure that a plant safe, stable condition (hot standby) could be achieved and maintained. Where droop conditions could degrade component response time, such components would not have been essential for achieving or maintaining hot standby during the early stages of an event and degraded response times would not have compromised maintaining safe shutdown.

Reactor Coolant Pump (RCP) Performance Impact

Under LOOP conditions the RCPs are stripped from their respective bus but seal cooling is required to prevent seal [EIIC: SEAL] damage. Seal cooling can be provided by either seal injection flow via a Charging [EIIS: CB] pump or thermal barrier cooling via a CCW pump. Since Charging pumps must be manually loaded, whereas CCW pumps are automatically loaded under LOOP conditions, the cooling function would likely have been provided via CCW flow to the thermal barrier. Per UFSAR Tables 8.2-2a and b, the CCW pump is loaded onto the bus in the first minute. Under droop conditions, the available CCW flow rate is expected to be lower than normal such that seal temperatures would tend to increase more rapidly. However, loss-of-seal-cooling for much longer periods has been evaluated (up to 10 minutes for station blackout) and not likely to result in seal damage. Therefore, even degraded flow under droop conditions is considered bounded by conditions postulated under design basis transient scenarios.

Hydrogen Generation Assumptions Impact

Based on the minimal impact to the design basis LOCA discussed below, operation of the EDGs in the droop mode would not impact containment post-accident hydrogen generation rate or the maximum assumed concentration of hydrogen in containment. Turkey Point has been exempted from the post-accident hydrogen control requirements of 10 CFR 50.44 and 10 CFR 50, Appendix A, General Design Criteria 41, 42, and 43. Thus, Turkey Point does not rely on hydrogen concentration control equipment to maintain hydrogen gas generation below flammability limits.

The exemption was based in part on recent industry studies which concluded that large dry containment building designs such as those at Turkey Point, have a very low risk of failure from hydrogen combustion during a design basis LOCA. The current industry approach is to let the hydrogen accumulate and burn inside containment. Due to the large number of random ignition sources inside containment (e.g., sparks from electrical equipment, small static discharges), it is expected that hydrogen concentrations above the flammability limit will not last very long inside containment without being ignited. Hydrogen combustion under these conditions does not produce any dynamic or impulsive loads on the containment building and is readily accommodated by the building design.

An underlying premise of this exemption is that the containment atmosphere is well mixed. Turkey Point currently credits operation of the emergency containment cooler fans for providing this mixing function. Two of three coolers are assumed to operate during a LOCA. These fans draw the post-accident air-steam mixture from lower levels of the containment building and discharge vertically to the upper region of the containment building. The flow rate from these fans (25,000 cfm each) would be affected by EDG operation in the droop mode. However, other circulating fans would also contribute to this mixing function. Two emergency containment filter fans (37,500 cfm each) would similarly mix the containment atmosphere and compensate for any reduction in cooler fan flow rate caused by the EDG droop condition.

Based on the above, there is no adverse impact on containment hydrogen generation.

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Control Room HVAC and Emergency Containment Filter Performance Impact

The Control Room Emergency Ventilation System (CREVS) [EIIS: VI] and Emergency Containment Filter [EIIC: FLT] (ECF) System [EIIS: VA] both use forced air flow through a charcoal filter bank for dose reduction purposes. The ECFs function to remove radioiodine from the containment atmosphere to reduce the potential for radioiodine releases from the containment boundary and minimize offsite doses. The CREVS charcoal filter functions to remove any radioiodine that may be present in the control room makeup air (due to containment leakage) to minimize control room personnel doses.

The forced airflow through these filter units would be reduced from the nominal flow rate if the filter fans were being powered by an EDG operating in the droop mode. The impact of this flow reduction would be offset somewhat by improved filter removal efficiency. From a filter efficiency standpoint, the lower airflow rate would increase the filter residence time. Residence time is the amount of time that the inlet airstream is in contact with the charcoal in the adsorber [EIIC: ADS] tray. Both the CREVS and ECFs use a parallel arrangement of standard Type II charcoal adsorber trays. These modular trays are designed to have a 0.25-second gas residence time when the inlet airflow rate is 1000 cfm. Operating these systems at slightly reduced flow rates will cause the flow rate for each cell to decrease below 1000 cfm; increasing the gas residence (or contact time) above 0.25 seconds. Increasing the contact time increases the potential that the charcoal will adsorb a radioiodine molecule passing through the filter.

Although it is not evident whether the increase in filter efficiency would fully compensate for the decrease in filter flow rate, the analytical margin available in the plant dose analyses is sufficient to envelop any net decrease in filter system performance. For example, the minimum acceptable filter removal efficiencies contained in the plant technical specifications exceed those used in the LOCA dose calculations. Additionally, the as-found containment leak rate is significantly lower than the analytical assumptions.

The LOCA dose analysis assumes an ECF removal efficiency of 30% for methyl iodide. However, the minimum ECF removal efficiency for methyl iodide allowed by Technical Specifications is 65%. The analysis also assumes 95% methyl iodide removal efficiency for the CREVS filter. However, the minimum CREVS removal efficiency for methyl iodide allowed by Technical Specifications is 97.5%.

The containment leak rate currently assumed for the LOCA in the UFSAR is 0.25% per day for the first 24 hours and 0.125% per day thereafter for the duration of the accident. The most recent containment integrated leak rate test for Turkey Point Unit 3 was performed on November 14, 1992. The results of that test indicate an as-found leak rate of 0.139% per day using the BN-TOP-1 analysis method, and 0.113% per day using the mass point analysis method.

Small-Break LOCA Impact

The SBLOCA analysis of record (AOR) in UFSAR Section 14.3.2.2 has more than 500°F margin to the peak clad temperature (PCT) limit of 2200°F. It should be noted that this analysis is based on conservative assumptions that do not reflect actual plant conditions (more benign peaking factors, shorter safety injection actuation time, etc.) that would have been present at the time of the EDG droop mode condition. Although there is sufficient margin in the AOR to accommodate the impact of the high head safety injection (HHSI) [EIIS: BQ] pumps operating in the droop mode of operation, estimates of this impact have been developed for postulated scenarios with one and two single failures.

For events requiring HHSI delivery the Turkey Point plant is configured so that the affected unit has at least 3 HHSI Pumps aligned to deliver flow. This is based on 2 HHSI pumps from the affected unit and 2 HHSI pumps from the other unit minus 1 HHSI pump from either unit lost due to a credible single failure. Step 18 of Procedures 3/4-EOP-E-0 (Reactor Trip or Safety Injection) requires the operator to realign 2 HHSI pumps to the affected unit. Operations personnel have indicated that SI realignment will not occur until at least 10 minutes after reactor trip.

Based on the above it can be concluded that in the event of a SBLOCA, 3 HHSI pumps would have delivered flow into affected Unit 3 for at least 10 minutes. This assumes a single failure. If the single failure occurred in Unit 4, 2 of the 3 available HHSI pumps would have been in the droop mode.

The SBLOCA analysis of record in UFSAR Section 14.3.2.2 demonstrates that only one HHSI pump is necessary to prevent unacceptable consequences. Therefore, the worst realistic SBLOCA scenario that could have occurred during the droop mode period, with an assumed single failure, is bounded by the SBLOCA analysis of record.

Large-Break LOCA and Long Term Cooling Impact

The Turkey Point Units 3 and 4 Best Estimate Loss of Coolant Accident (BELOCA) analysis is limited by the no LOOP condition. The initial transient limiting reflood peak cladding temperature is 1756°F, which is 103°F higher than the LOOP transient PCT of 1653°F.

The lower plenum pressure for the Turkey Point Units 3 and 4 reference transient run is approximately between 30 and 40 psia (15 and 25 psig) for nearly the entire transient after the first 20 transient seconds. The SI flow delay for the LOOP transient is 35 seconds; therefore, this is the pressure range for which the reduction in SI flows is inspected.

The revised HHSI flow at 20 psig (midpoint of relevant pressure range) is 371 gpm. The analysis of record value at 20 psig is 382 gpm. The reduction in HHSI flow is then 11 gpm.

The low head (Residual Heat Removal) [EIIS: BP] flows with a 15 psig containment backpressure were used in the analysis of record with the exception of the 0 psig entry. There are several cases of revised low head flows, none of which corresponds to the 15 psig containment backpressure. The low head SI flow reduction at 20 psig varies between 42 gpm and 2 gpm depending on the case run. A linear interpolation is done between these values to estimate the flow reduction with a 15 psig containment backpressure.

(0.75)(2 gpm) + (0.25)(42 gpm) = 12 gpm reduction in low head SI flow

The total SI flow reduction at the desired pressure is therefore approximated to be 23 gpm.

A safety injection flow reduction PCT sensitivity was previously run for Turkey Point. The net result of this study was a negligible PCT benefit for the limiting time period for a total SI flow reduction of 30 gpm. It is concluded that the reference transient would not switch from no LOOP to LOOP based on the margin between the no LOOP and LOOP transients.

Since the no LOOP case continues to be limiting over the LOOP case even with the EDGs operating in droop mode, the existing BE LBLOCA analysis bounds Unit 3 EDG operation in droop mode.

The cold leg and hot leg LBLOCA recirculation flows were re-validated against the flows resulting from the EDGs operating in droop.

The cold leg recirculation minimum flow is bounded by the injection mode flows because credit is taken for miniflow line isolation. The analysis of record recirculation flow rate is 392 gpm, which corresponds to the LBLOCA HHSI flow at an RCS pressure of 0 psig. The LBLOCA HHSI flow calculated for the EDGs operating in droop mode at 0 psig is 447 gpm. This is 55 gpm higher than the flow assumed in the current analysis of record, therefore, cold leg recirculation minimum flows would have been met for the EDGs operating in droop mode.

The minimum flow requirement for hot leg injection during recirculation is 1.67 times the core boil-off. This was calculated to be 245 gpm. The current hot leg injection flow was calculated to be 255 gpm as documented in the analysis of record post-LOCA calculations.

Review of the fluid systems calculation for hot leg recirculation indicates that Turkey Point Unit 3 can actually achieve a minimum flow rate of 275.6 gpm. This provides additional flow margin above the 255 gpm currently documented in the analysis of record post-LOCA calculations. The total HHSI pump flow reduction is 16.3 gpm due to the droop mode condition for cold leg injection at 0 psig. Since the hot leg recirculation flow rate is approximately at the same point on the HHSI pump curve as the cold leg injection flow rate, it can be assumed that the system alignments are basically equivalent for both hot leg and cold leg injection. Therefore, the reduction in flow resulting from the EDGs operating in droop mode for cold leg injection can be applied to the hot leg recirculation flows. By applying the cold leg injection flow reduction, it has been determined that the 255 gpm hot leg injection flow rate remains valid for the EDGs operating in droop mode. Therefore, the minimum flow requirements for hot leg injection would have been met.

Non-LOCA Transients Impact

Key assumptions made for this functionality analysis include the following:

It is assumed that only the HHSI, containment spray, residual heat removal, and component cooling water pumps would have been affected.

The HHSI performance with offsite power available was assumed to be unaffected

The AFW pump performance was assumed to be unaffected with or without offsite power available.

The only non-LOCA events in Chapter 14 of the UFSAR that model the ECCS are the steamline rupture accidents discussed in Section 14.2.5. The steamline break accident discussed in Subsection 14.2.5.2 is the limiting event in this category and is the only one discussed here. Steamline break cases with and without offsite power are analyzed. Only the case without offsite power is potentially affected.

The steamline break with LOOP is typically non-limiting relative to the case with offsite power available due to the trip of the RCPs. RCP trip results in a less severe cooldown of the RCS, and therefore a less severe return to power. This is the case for the Turkey Point steamline break analysis, in which available offsite power resulted in a peak power of approximately 19% compared to approximately 14% calculated with LOOP.

RCS pressure decreases quickly in the steamline break event, so that by the time HHSI pumps are actuated the pressure has dropped to approximately 800 psia. At this pressure, the reduction in HHSI flow due to the EDGs operating in droop mode is about 4%. This small reduction in HHSI flow will not make the case without offsite power more limiting than the case with offsite power. Reactivity feedback is the primary mechanism for attenuating the power increase for this case. The addition of borated water via safety injection flow results in a slower power increase and lower peak power, but is not required to terminate the power increase. Based on a review of the current Turkey Point steamline break analysis and engineering judgment, a 4% decrease in HHSI flow will not result in a 5% increase in peak power. This is especially true considering that an additional HHSI pump could be credited in the analysis. The steamline break analysis conservatively credits just one HHSI pump, even though two would be available assuming the loss of one train of safety injection. Therefore, the DNBR for the case without offsite power available with reduced HHSI flow would be no less than the current limiting value for the case with offsite power available. As such, the acceptance criteria for this event would have continued to be met.

The non-LOCA events in Chapter 14 of the UFSAR are not analyzed beyond the short-term period. The only event for which the HHSI actuates is the steam generator depressurization/steamline break event. A change in flow rate during the recirculation phase of the event (if reached) would not yield more severe results than those calculated in the short-term analysis. By the time recirculation is reached, sufficient boron has been injected into the core to keep it subcritical. The HHSI flow itself is not needed for core cooling for this event.

SUMMARY AND CONCLUSION FOR EDG DROOP MODE IMPACT ON PLANT SAFETY

EDG operation in the droop mode results in a reduction of output frequency of approximately 5%, which translates to reductions in pump and fan motor speeds. For pumps, flow and head are reduced by approximately 5% and 10%, respectively; although affinity laws were used to more definitively estimate flow based on a 10% head reduction. Also, the effects of degraded pump performance become less critical with time into an event.

Although the defined equipment performance capability was degraded, valid assumptions for event and accident analyses were upheld. Assessment results show that no acceptance criteria or limits would have been exceeded had any of the design basis events occurred while the Unit 3 EDGs were in the droop mode of operation.

SAFETY SIGNIFICANCE OF GROUND TEST DEVICES INSTALLED IN THE INTAKE AND COMPONENT COOLING WATER BREAKERS

Racking in the GTDs in the 4 kV Bus A or B ICW or CCW switchgear cubicles creates logic indicating that a breaker is installed in the cubicle. For a LOOP only, one ICW and one CCW pump are permitted to be automatically loaded on each EDG. The control circuit for ICW or CCW Pump C, on swing Bus D switchgear, will only permit automatic loading on the EDG, if the breaker of the ICW or CCW pump of the bus it is aligned to (A or B) is not racked in. This is accomplished by providing a 152HH contact from a A ICW or CCW cubicle in series with the A sequencer start signal in the ICW or CCW Pump C control circuit. The same is done with a 152HH contact from a B ICW or CCW cubicle in series with the B sequencer start signal in the ICW or CCW Pump C control circuit. With the GTD installed in a A or B ICW or CCW switchgear cubicle, the D Bus ICW or CCW breaker will not receive a close signal for a LOOP. As such, no ICW or CCW pump would be loaded onto the associated EDG for a LOOP. However, the D switchgear ICW or CCW pump would operate prior to a LOOP and would be available to be manually started and loaded on the EDG from the control room via the ICW or CCW control switch. Procedures 3/4-EOP-E-0, Steps 9 and 10, direct operators to verify proper CCW and ICW operations and to start or stop pumps as needed.

The ICW and CCW switchgear and associated equipment are on the 10 CFR 50, Appendix R Essential Equipment List (EEL). Fire induced short and open circuits of the cables [EIIS: CBL] connected to the subject switchgear 152HH or 152TOC contacts could create similar logic as discussed in this evaluation. However, these cables are already evaluated and addressed in the safe shutdown analysis (SSA) for fire zones where the cables are exposed to a fire. In fire zones where the cables are not exposed to a fire, the D switchgear ICW or CCW pumps could be credited by the SSA as available. With the GTD installed in a A or B ICW or CCW pump cubicle, the D switchgear ICW or CCW pump would not have automatically loaded on the EDG for a LOOP. However, the D switchgear ICW or CCW pump can be, and would be, started by procedures (3/4-EOP-E-0) using the control room control switch, after automatic EDG loading is completed. As such, the GTD being installed in the cubicle would not have prevented the ICW or CCW pump from being available for safe shutdown of the unit.

Racking in the GTDs in the 4 kV Bus A or C Feedwater (FW) pump switchgear cubicles creates logic indicating that a breaker is installed and racked up in the cubicle. A contact of the 152HH or 152TOC switch is used in the feedwater recirculation circuit for valves CV-3/4-1415 and 1416 for FW pump 3/4A and valves CV-3/4-1417 and 1418 for FW pump 3/4B. With the GTD installed in a FW pump cubicle, the 152HH or 152/TOC contact would cause the recirculation valves for the associated feedwater pump to open with the pump not operating. This condition has no impact on safety.

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CONCLUSION FOR GTDS INSTALLED IN INTAKE AND COMPONENT COOLING WATER BREAKERS

With the GTD installed in a Unit 3 A or B ICW or CCW pump switchgear cubicle, the D switchgear ICW or CCW breaker will not automatically close on a LOOP signal. Therefore, the D switchgear ICW or CCW pump would not be automatically loaded onto the associated EDG for a LOOP scenario. However, the D switchgear ICW or CCW pump would operate prior to a LOOP and would be available to be manually started and loaded on the EDG from the Control Room via the control switch after the sequencer automatic loading, per procedures 3/4-EOP-E-0.

The health and safety of the public were not affected by the events discussed above.

CORRECTIVE ACTIONS

1. A procedure change was completed to place a jumper in the Unit 3 startup transformer breaker/cubicles (3AA05 and 3AB05), when the startup transformer is removed from service for maintenance. This ensures that the Unit 3 EDGs (3A & 3B) will start in isochronous mode, not the droop mode, if required.

2. Appropriate procedures have been revised to install jumpers at the ICW and CCW pump cubicles, whenever a pump is taken out of service, to ensure that the associated D switchgear ICW or CCW pump will start for a LOOP.

3. The Condition Report documenting the disposition of this condition was distributed to all Engineering personnel as required reading to emphasize the importance of considering the effects on the plant of equipment that interfaces with plant systems during maintenance and surveillance activities.

ADDITIONAL INFORMATION

EIIS Codes are shown in the format [EIIS SYSTEM: IEEE system identifier (EEIS), component function identifier (EIIC), second component function identifier (if appropriate)].

FAILED COMPONENTS IDENTIFIED: NONE

SIMILAR EVENTS

A search of Turkey Point and Institute Of Nuclear Power Operations (INPO) operating experiences did not identify any similar events.